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High Speed Plasma Diagnostics Instrumentation
DURIP - 99

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8. PERFORMING ORGANIZATION
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13. ABSTRACT (Maximum 200 Words)

Equipment required for the performance of research funded by DoD agencies was purchased and installed in the grantee's laboratories. This included a spectrograph, image intensifiers, CCD detectors, several oscilloscopes, pulse generator and other ancillary equipment.

The proposed equipment list and the actual equipment purchased list with prices is presented and changes noted. This equipment has been used on the projects "Tri-University, Multidisciplinary, High Energy, Microwave Device Consortium" (AFOSR/DoD MURI), "Fundamental Limits to Compact, Expendable Pulsed Power and Microwave Sources" (AFOSR New World Vistas), High Power Microwaves (AASERT), and AFOSR MURI Explosive-Driven Pulsed Power Generation..

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High Speed Plasma Diagnostic Instrumentation

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Final Technical Report
On
High Speed Plasma Diagnostics Instrumentation

DURIP – 99

August 31, 2000

Air Force Office of Scientific Research

Grant No. F 49620-99-1-0146

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USE OF THE EQUIPMENT

The equipment purchased with the funds provided by the DURIP grant (\$161,713) and the matching funds provided by Texas Tech University (\$40,000) has been used on the following projects:

1. MURI 98 Explosive-Driven Pulsed Power Generation (Grant No. F49620-98-1-0440).
2. Fundamental Limits to Compact, Expendable Pulsed Power and Microwave Sources (AFOSR New World Vistas), Grant No. F49620-97-1-0476).
3. Tri-University, Multidisciplinary, High Energy Microwave Device Consortium, a MURI '94 grant, administered by AFOSR (Grant No. F49620-95-1-033) which includes:
 - i) Subnanosecond breakdown of insulators such as gas, liquid, solid, and surface for ultrawide band source development.
 - ii) Relativistic Klystron Oscillator (10 GHz) diagnostic to determine the cell to cell coupling, the input and output coupling factor, parasitic mode coupling, and cavity field distribution, and the design, fabrication and testing of a 94 GHz klystron.
 - iii) Cavity and microwave window breakdown diagnostic, including field distribution and amplitude time history, microwave power, and visible and x-ray emission caused by the breakdown.
 - iv) High Power Microwave Generator (AFOSR Grant No. 49620-93-1-0203) which was changed from the original goals to the investigation of a novel cylindrical vircator microwave source.
4. High Power Microwaves, (AFOSR Grant No. F49620-91-1-0299) which is a supplementary grant (AASERT) to support a Ph.D. candidate in charge of the research.

EQUIPMENT LISTS

The equipment originally proposed is listed in Table 1. The equipment actually purchased is listed in Table 2. The changes are explained by item number following Table 2.

Table 1 - Equipment Originally Proposed

Item	Description	Qty	Price
1	Hewlett Packard Infinium Oscilloscope – 8 GSa/s, 4 ch, 32 K Points, 1.5 GHz, color, analog-like front panel, Windows™ 95-based GUI, built-in information system. Includes 4 1161A probes. Purchase Agreement No: G7R36 20% University Discount Contact Person: Harry Rosenberg, 1-972/699-4341	2 ea.	\$47,992
2	OMA system, Oriel Instruments. Main Properties: 1. Gateable down to 2.5 ns 2. Image Intensifier 28 lp/mm 3. Gating On/Off ratio 10 ⁶ 4. Spectral sensitivity range 180 nm - 850 nm 5. 1024 x 256 pixel, size 26 µm 6. Spectral dispersion: variable 1.6 - 12.8 nm/mm 7. Thermoelectric cooled 8. Corrected optics for spectrographic imaging 9. Computerized control, readout rate up to 1 MHz 10. True 16 bit dynamic range, read noise < 10 electrons Contact Person: Denise Chew Phone (203) 377-8282	1 ea.	\$61,221
3	XSI X-ray and Specialty Instruments, Inc. 18 mm MCP Image Intensifier/Converter Includes: 1. sealed with quartz window 2. 1 MCP 18 mm active area 3. .75 mm MCP to phos spacing 4. P20 phosphor 5. S20 photocathode 6. gated operation to 5 nses. 7. includes all electronics for gated operation from 5 ns to DC 8. 15 lp/mm Contact Person: Daniel Gorzen (734) 761-7400	5 ea,	\$92,500

Total Cost	\$201,713
TTU Match	<u>\$ 40,000</u>
AFOSR Request	<u>\$161,713</u>

Table 2
EQUIPMENT ACTUALLY ORDERED

Item	Vendor	Pur- chase Order No.	Product	Qty	Unit Price Plus Shipping	Total
1	Oriel Instruments	010059	Spectrograph/ Fiber Optic System	1	16,969.72	16,969.72
2	Andor	010060	Intensified CCD Detector	1	42,700.00	42,700.00
3	Maxwell Physics International	010493 010614	300 kV FXR System with Single Remote Tubehead	1	42,000.00	42,000.00
4	Hewlett Packard	010729	Infinium Oscilloscope	5	14,246.25	11,196.00*
5	Ziemer & Associates	010706	Image Intensifier	1	20,060.00	562.65*
6	Hewlett Packard	912210	Infinium Oscilloscopes	2	1@15,196.00 1@12,796.00	27,992.00
7	Stanford Research Systems, Inc.	912420	Digital Delay/ Pulse Generator	2	4,774.71	9,549.43
8	Oriel Instruments	916782 (912362)	Fiber Optic Matcher, Fiber w/ SMA Terminations, Fiber Adapter	1 Sys.	2,969.34	2,969.34
9	Test Equity	916864	Oscilloscope Measurement Modules System	3	2,231.62	6,694.86
10	Edmund Scientific	956500	Pump Laser, Laser Module	1	1,079.00	1,079.00
Expenditures						161,713.00
Grant F 49620-99-1-0146 Funding						161,713.00
Balance						-0-

11	Apogee	010707	Cooled CCD Camera	1	23,250.00	3,250.00
12	Hewlett Packard	010729	Infinium Oscilloscope	1	14,246.25	4,000.00*
13	Ziemer & Assoc.	010706	Image Intensifier	1	20,060.00	12,750.00*
Expenditures						40,000.00
TTU Matching Funds						40,000.00
Balance						-0-

* Partial payments, remainder paid from other accounts.

CHANGES

Table 1, item 1: Two Hewlett Packard Infinium Oscilloscopes. A total of 8 Hewlett Packard oscilloscopes with somewhat differing specifications and 3 oscilloscope measurement modules were purchased; see Table 2, item 4, 6, 9, 12. Due to partial payments, i.e. the remainder of the purchase price paid from other accounts, the cost for the purchased equipment remained about the same as in Table 1, item 1; \$49,882.00 vs. proposed \$47,992.00.

Table 1, item 2: OMA system, Oriel Instruments. Oriel stopped selling image intensifier cameras. The camera from Andor Technology was chosen as a replacement, Table 2, item 2. The spectrograph and the fiber optic matcher, Table 2, item 1 and 8 remained unchanged from the originally proposed equipment. The actual cost for the three items in Table 2 was \$62,639.06 as compared to the proposed \$61,221.00

Table 1, item 3: Five image intensifier from XSI X-ray Specialty Instruments, Inc.. Due to a change in direction of our research between when this DURIP was proposed and when it was awarded, not all of the five image intensifiers were purchased. Additionally, we switched to Ziemer Assoc. and Apogee since their products seemed to be more satisfying. In Table 2, the items 5, 11 and 13 correspond to what was originally proposed. Also, item 7, two delay pulsers, was needed for timing the intensifier exposure time with nanosecond accuracy as it is necessary in high speed plasma diagnostics. With the image intensifiers purchased on this grant and the image intensifier cameras purchased from other accounts, the purchase of an additional intensifier was not as vital for the MURI 98 Explosive-Driven Pulsed Power Generation research as the 300 kV pulsed x-ray flash photography system, Table 2, item 3. The laser, Table 2 item 10, is used to help aiming the x-ray radiation at the target.

Although we originally requested equipment that was needed for our research at the time the proposal was written, the flexibility to modify the requested equipment greatly enhanced our current research. We feel that these changes are easily justified given the fast pace cutting edge research that is being performed.